

NISTTech

Humidity Chamber for Scanning Stylus Atomic Force Microscope (AFM) with Cantilever Tracking

Improves high resolution imaging in the subnanometer level under ambient conditions by controlling humidity levels

Description

Improve imaging by controlling the humidity level of the environment local to the probe of a scanning stylus atomic force microscope. The humidity chamber provides either humidity-free or humidity intense environments in which a specified humidity level can be maintained. The geometrical design of the humidity chamber allows the AFM scanner, tip assembly (probe), optical lever detection system, sample, and if necessary, a side-mounted optical microscope objective lens (camera), to be fully enclosed without degrading significantly the ability to operate the AFM or the related systems. Because the AFM senses the surface by "touch", it allows imaging of nonconducting materials such biological and molecules, plastics, ceramics, and insulating materials like glass or diamond, with nanometer resolution.

During imaging in ambient conditions, surface contamination will occur due to the presence of moisture in the form of humidity that will adsorb onto the sample surface. The amount of adsorbed moisture, which will depend on the ambient relative humidity, can affect AFM imaging and force measurements. When the tip of the AFM probe scans over a moist sample, it sometimes takes a hopping motion because of the way the water molecules are layered. This hopping motion, is believed to affect a sample's image quality. Therefore, controlling the humidity level during scanning becomes an important factor when using the AFM.

Applications

- **Nanomanufacturing research**
Solve problems in electronics, telecom, biology and other high-tech industries.

Advantages

- **Control over local environment**
Improve imaging under a variety of humidity conditions.

Abstract

The present invention provides a novel humidity chamber suitable for use with an atomic force microscope (AFM). The humidity chamber of the present invention employs an intricate geometrical design which can accommodate a scanned-stylus AFM with an optical lever. This geometrical design allows the invention to enclose one or more of the AFM scanner, tip assembly, optical lever detection system, sample and an optical microscope objective lens, without degrading the ability to operate the AFM or the related systems. The invention is comprised of two major pieces: a chamber within which the AFM scanning head assembly is placed, and an integrated sample platform and spring-loaded base-plate that allows samples to be loaded and unloaded without removal of the chamber from the AFM scanning head assembly. The sample platform, which extends up from the base-plate and is inserted into the chamber, can include a magnet that is securely attached to the base. Once the sample platform is positioned inside the chamber, a locking pin can be inserted between the chamber and the bottom portion of the sample platform to secure the sample platform and base-plate. The spring-loaded base allows the z-directional motors of the AFM to be used to position the sample just below the probe prior to scanning, while at the same time providing an essentially air-tight fit between the chamber and the AFM scanning head. An embodiment of the present invention is suitable for use with components that sense and control the relative humidity inside the chamber.

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References

- U.S. Patent #6,490,913 issued 12-10-2002, expires 05/18/2020
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Status of Availability

active patent and available for licensing

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